

R E P O R T R E S U M E S

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THE USE OF PROGRAMED INSTRUCTION IN INTRODUCTORY PSYCHOLOGY
FOR TEACHERS.

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THE RELATIONSHIPS AMONG RELEVANCY OF CONTENT, MODE OF
PRESENTATION, AND LEARNING OUTCOMES AS MEASURED BY OBJECTIVE
TESTS OF PSYCHOLOGICAL KNOWLEDGE IN AN INTRODUCTORY COURSE IN
PSYCHOLOGY FOR TEACHERS WERE STUDIED. ALL STUDENTS ENROLLED
IN A TWO-QUARTER COURSE WERE RANDOMLY DIVIDED INTO FIVE
GROUPS AT THE BEGINNING OF THE FALL QUARTER OF 1963. FIVE
EXPERIMENTAL TREATMENTS WERE ASSIGNED TO THE GROUPS AFTER
THEY RECEIVED A 230-ITEM MULTIPLE-CHOICE PRETEST. THE FIVE
TREATMENTS WERE--(1) A PROGRAMED TEXT AND LECTURES, (2) A
TEACHING MACHINE PROGRAM AND LECTURES, (3) A PROGRAMED
WORKBOOK, A TEXTBOOK, AND LECTURES, (4) A TEACHING MACHINE
PROGRAM, LECTURES, A TEXTBOOK, AND ASSIGNED READINGS, AND (5)
LECTURES AND ASSIGNED READINGS. THREE OBJECTIVE EXAMINATIONS
WERE ADMINISTERED DURING EACH QUARTER. DATA WERE ANALYZED
USING AN ANALYSIS OF COVARIANCE WITH PRETEST SCORES AS THE
COVARIATE, AND POST-TEST SCORES AND EXAMINATION POINTS AS
CRITERIA FOR PERFORMANCE CHANGE. RESULTS OF THE STUDY WERE
AMBIGUOUS. A SINGLE CONCLUSION WAS SUGGESTED WHICH IS--THE
MOST IMPORTANT VARIABLE IN LEARNING IS THE AMOUNT OF TIME
SPENT IN LEARNING. (HB)

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FINAL PROJECT REPORT

**"The Use of Programed Instruction in Introductory
Psychology for Teachers"** FINAL REPORT

William A. Hunt

Claude Mathis

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"The Use of Programed Instruction in Introductory
Psychology for Teachers

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No area of research has seized the imagination of the researcher in learning during the last ten years as that of automated learning and programed instruction. In a recent review of the literature, Schramm (1964), points out that approximately 190 reports of original research on programed instruction have appeared in the literature since the 1954 publication of Skinner's article, "The Science of Learning and the Art of Teaching." Of these 190 reports, 165 have a publication date beyond 1959. These articles do not include the multitude of comments on programed instruction which do not involve any original experimental data, nor do they include many reports of research and comments appearing in papers presented at professional meetings but not subsequently published.

Both Schramm (1964) and Stolurow (1961) in an earlier survey of research on programed instruction, conclude that the effectiveness of programed instruction techniques in promoting learning is a firmly established principle. While this conclusion may project a degree of certainty, it is not to be interpreted as meaning that an answer has been found to the question of how well students learn from programs and from automated instruction techniques in comparison to how well they learn from other modes of instruction. The answer to relative gains in learning is an inconclusive one with respect to the present state of research knowledge in programed instruction.

An attempt to survey the research literature in this report will not be made. Attention should be directed to the reports of Schramm (1964) and Stolurow (1961), who accomplish in a thorough fashion the objectives of a research summary of results available from studies of automated instruction and programmed learning. According to Schramm (1964), the major variables occupying the time of the researcher in programmed learning are such factors as the sequence to be followed in presenting a program of information (random versus ordered), step size to be used in constructing the program, the construction of the response to be given by the learner (written versus "thinking" responses), the efficacy of immediate knowledge of results, the advantages of self pacing in learning, and such factors as age, sex, and ability differences in learning.

Problem and Procedure:

The research reported here attempted to obtain relevant data pertaining to some dimensions of programmed learning which are not part of the characteristic pattern of variables generally found in the literature. Specifically, this report presents the results of an experiment involving programmed learning, in a typical college classroom, designed to study the relationship between content dimensions (both relevant and irrelevant) and method of presentation (teaching machine and programmed textbook). The objectives of the research were twofold: (1) To develop a procedure for the use of automated instructional devices and programmed learning to supplement the methods traditionally used in the teaching of an introductory psychology course for prospective public school teachers; and,

(2) To evaluate the learning outcomes resulting from the use of programmed text material which is highly relevant and a highly relevant program presented by a Skinner-type teaching machine, as opposed to learning outcomes resulting from the use of programmed text material which is only slightly relevant and a slightly relevant program presented by a Skinner-type teaching machine.

The design of the experiment and the procedure followed in implementing this design was as follows:

- a. **Subjects:** Subjects for the study consisted of male and female undergraduates at Northwestern University who were enrolled in a two-quarter course, Ed./Psy. A12, 1,2, "Psychology for Teachers." This course was a requirement for all persons planning to enter the profession of teaching and consisted of content traditionally taught separately as general psychology and educational psychology. The course was taught and administered jointly by the School of Education and the Department of Psychology. Out of an original enrollment of 130 students, 114 subjects remained in the course throughout the two quarters and constituted the total sample for the research.
- b. **Treatments:** At the beginning of the Fall Quarter, September, 1963, the students enrolled in A12 were divided equally and randomly into five groups. Each group was further randomly assigned to an experimental treatment or to a control condition for the duration of the experiment. Four of these groups

were exposed for the two quarters to different experimental treatments involving the use of highly relevant and slightly relevant materials presented through the use of a teaching machine and a programmed textbook. The fifth group was given only the traditional lecture and textbook materials.

Thus, the control group received the regular lectures plus assignments in E. R. Hilgard's Introduction to Psychology, 3rd ed. (1962), and further assigned readings from The Scientific American.

The two experimental groups subjected to the "highly relevant" condition were required in addition to the above to go through the programmed workbook or Student Guide prepared by Teevan and Jandron (1962) for use with Hilgard's text. Published by Harcourt, Brace and World, it consists of 1,350 frames of the constructed response type with no branching. One group used it as a programmed text. For the other group, the 1,350 frames were adapted for automation by being put on a continuous tape for use in the Rheem Califone Didak 501 machine.

The "slightly relevant" conditions utilized the programmed text by James G. Holland and B. F. Skinner, The Analysis of Behavior (1961). This is a text consisting of 2,000 frames which presents a Skinnerian point-of-view in introductory psychology. For one group it was used in its original form as a programmed text, for the other it was put on a tape for use in the Didak machine.

The regular lectures and discussions were given to the entire class during the regularly scheduled class meetings. Those students having assignments in programmed text or on teaching machines executed them in

addition to the regular class hours. These experimental groups were allowed to set their own pace with the programmed materials.

In summary, the randomly constituted groups received the following treatments:

Group A - Holland and Skinner programmed text in addition to regular lectures, the Hilgard textbook, and assigned readings.

Group B - Holland and Skinner programmed text materials presented through a Rheem Califone Didak 501 Machine in addition to regular lectures, the Hilgard textbook, and assigned readings.

Group C -- The Teevan and Jandron programmed workbook for the Hilgard text in addition to the Hilgard text, regular lectures, and assigned reading.

Group D - The Teevan and Jandron programmed materials for the Hilgard text presented through a Rheem Califone Didak 501 Machine in addition to regular lectures, the Hilgard text, and assigned readings.

Group E - Regular lectures and the Hilgard text plus assigned readings.

c. **Criteria for Performance Change:** At the beginning of the Fall quarter, before the start of class lectures, the total class was given a test of psychological knowledge consisting of random items picked from the multiple-choice items available for the Hilgard text, Introduction to Psychology (1962). These items were obtained from an item pool available to accompany the Hilgard text. Each chapter of the text is represented by twenty multiple-choice items. From this item pool, a balanced number

of items were randomly picked from each chapter so that a random item test of 230 multiple-choice items was assembled. This pre-test was administered on two successive days with 115 items presented to the total class on the first day and 115 items on the second day. In addition, during the Fall quarter, two 50 item examinations and one 100 item examination consisting of multiple-choice items chosen from the same Hilgard item pool, but avoiding the items used in the pre-test, were administered. These were given at appropriate intervals so that each test covered approximately one-third of the course and did not include material previously tested. The last of these three tests, the 100 item examination, was given during the final examination period for the Fall Quarter.

Except for the pretest the same testing procedure was followed during the Winter Quarter, with three multiple-choice tests being administered, consisting of the same number of items as during the Fall Quarter, covering approximately one-third of the course at each testing. The lectures and Hilgard textbook assignments were arranged so that approximately the first half of the Hilgard text was covered during the Fall Quarter and the last half during the Winter Quarter.

At the end of the Winter Quarter during the last week of class and at the end of the course lectures, the pre-test

consisting of 230 randomly selected Hilgard items was again administered in a two day sequence with 115 items being given the first day and 115 the second. This post-test was identical to the pre-test given at the beginning of the course.

- d. Instructions given to the groups: At the beginning of the Fall Quarter the instructors explained to the students that, in addition to the instruction they would receive in the course, they would be involved in a research project which would allow them to gain some insight into experimental procedures in general and the process of experimentation in learning. They were told that they would be divided into various groupings, but that the groupings would have no influence on the grade they would receive in the course. They were also told that some groups would be given various tasks to complete and that their selection for a particular group was based on chance and not on any abilities they might or might not possess. The point that group assignment would not influence their grade was stressed throughout the course. The instructions were such that the investigators felt that the students were motivated to participate and respond. At the same time the instructions were not so detailed as to appraise the students of the specific purposes of the experiment.

Each of the four experimental groups (A,B,C,D) was given

III. An additional detailed instructions concerning the use of the teaching machines and the programed texts. A capable student assistant was in charge of scheduling the use of the machines. He was present and available during both quarters at specific times during the week in an automated instruction laboratory in the basement of a campus building easily accessible to the students. The students in the teaching machine groups (B and D) were allowed to set their own pace in scheduling appointments, but they were expected to complete an assigned number of units of each program during one quarter. The students in groups A and C were issued copies of the appropriate programed text material and were encouraged to use them and to respond to the items by writing in the books. A copy of the instructions for groups A, B, C, and D is given in Appendix I.

At the beginning of the Fall Quarter the five groups consisted of approximately 27 students each. However, normal attrition was such that the analysis of results was based on the following number of subjects in each group:

Group A - 22

Group B - 23

Group C - 23

Group D - 23

Group E - 23

Results:

The results of the analyses of data are presented in Tables I through

Tables I through XIII are on pages 13 through 19.

XII. An analysis of covariance procedure was used with scores of the Pre- and Post-Achievement test as covariant and criterion in one type of analysis, and Pre-test achievement scores and total examination points for the Winter Quarter as covariate and criterion in another type of analysis. Analysis of covariance was considered an appropriate statistic for the treatment of the data since the adjustment of the criterion for regression on the covariate as is done in analysis of covariance controls variation as far as this variation is influenced by linear correlation or regression effects (see Winer, 1962, pp 578-621).

In all of the analyses represented in Tables I, III, V, VII, IX, and XI,¹ scores on the 230 item test of relevant psychological knowledge given at the beginning of the Fall Quarter were used as covariates. The criteria for achievement, or changes in performance, were either the scores on the 230 item test given at the end of the course or the total number of examination points obtained during the Winter Quarter from the three examinations given during that quarter. Winter Quarter examination points were used because an analysis of Fall Quarter examination points indicated no significant differences between conditions. In addition the machine groups were not able to start their experimental trials until two weeks after the beginning of the Fall Quarter, and it was felt that the cumulative effects of changes in achievement would be more pronounced during the Winter Quarter.

As can be seen from Tables I and III, no significant differences were obtained, using the Post-test achievement scores and the examination points as criteria, in a comparison of all five groups; although Tables II and IV

¹Tables I through XIII are on pages 13 through 19.

do present evidence of a trend in mean scores favoring the experimental groups. Differences were obtained, however, at greatly beyond the .01 level of significance in comparing Pre- and Post-Test scores for the class as a whole.

Since no attempt was made to control the use of the programed text by experimental groups A and C, other than to impress on the students the necessity and importance of using them for purposes of the experiment, an assessment of their use was made at the end of the course. These results are presented in Table XIII. A majority of students in group A indicated that they used the Holland-Skinner programed text infrequently, while a majority of students in group C indicated a use of the Teevan-Jandron programed material most of the time. For this reason, an analysis was made combining group A with experimental group E and testing for differences between four groups instead of five. As can be seen from Tables V and VII, no significant differences were obtained, although Tables VI and VIII indicate a trend in means in favor of the experimental groups.

Because of this trend, it was decided to treat the experimental groups B, C, and D as one group, and to compare this larger experimental group to the already combined groups A and E which made up the control group for the comparison. The increase in the number of subjects in the groups was thought to offer a better basis of ascertaining significant differences between means where trends were already evident. The results of these analyses are presented in Tables IX and XI. These two groups did differ significantly (at between the .05 and .01 level of confidence) in the analysis of pre- and post-test scores on the 230 item test of relevant psychological

knowledge, and they differed significantly (at between the .05 and .01 level of confidence) in the analysis of pre-test and total Winter Quarter examination points.

Discussion:

In discussing the results it might not be out of order to indicate that the gains in scores between the pre- and post-test of relevant psychological information does demonstrate that it is possible to teach the content of the Hilgard text in an introductory course in psychology. At the risk of doing the authors an injustice it also seems possible to infer that the students were not attracted by the Holland-Skinner text, remembering that when it was put on a tape for machine use and students were required to schedule appointments, it seemed to have more attention value.

In general, our results resemble those of other "shotgun" type experiments in the classroom in which the significant variables are difficult to define and are obscured by the small size of samples used. At the risk of proceeding with only minimal justification, the experimenters would like to offer their explanation of the difference that does appear when the three effective experimental conditions are treated as one and the control condition is combined with the ineffective experimental condition (the non-use by the students of the Holland and Skinner text), although there are no differences between the four experimental conditions themselves. Following Underwood (1959) we would suggest that the single most important variable in learning is the time spent in learning and that the outstanding difference between our effective experimental conditions and the control

conditions was that the experimental conditions assured an added time involvement by the students in the learning process. Any further discussion is certainly inappropriate in view of the ambiguity of the results.

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Table 1

Analysis of Covariance of Achievement Test Scores Obtained
By Groups A, B, C, D, and E

Pre-Test = Covariate
Post-Test (same instrument) = Criterion

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Treatments	1415.9127	4	353.9782	1.6570
Error	23071.2302	108	213.6225	
Total	24487.1429	112		

Table II

Pre-test and Post-test Means of Achievement Test Scores
Obtained By Groups A, B, C, D, and E

	<u>n</u>	<u>Pre-Test</u> <u>Mean</u>	<u>Post-Test</u> <u>Mean</u>	<u>Post-Test</u> <u>Mean (Adjusted)</u>
A	22	81.0909	116.9091	117.1290
B	23	81.6522	122.2609	121.9320
C	23	80.6522	122.3043	122.9530
D	23	83.1739	123.2174	121.4009
E	23	80.0000	112.3043	113.5906

Table III

Analysis of Covariance of Winter Quarter Examination
Points Obtained by Groups A, B, C, D, and E

Pre-Test = Covariate
Final Points = Criterion

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Treatments	593.6457	4	148.4114	1.1741
Error	13651.7624	108	126.4052	
Total	14245.4081	112		

Table IV

Means for the Pre-Test and Winter Quarter Examination
Points for Groups A, B, C, D, and E

	<u>n</u>	<u>Pre-Test</u> <u>Mean</u>	<u>Final Point</u> <u>Mean</u>	<u>Final Point</u> <u>Mean (Adjusted)</u>
A	22	81.0909	163.0454	163.1239
B	23	81.6522	168.5217	168.4043
C	23	80.6522	167.1739	167.4054
D	23	83.1739	167.1739	166.5256
E	23	80.0000	162.3043	162.7634

Table V

Analysis of Covariance of Achievement Test Scores
Obtained by Groups A+E, B, C, and D

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Treatments	1283.4815	3	427.8272	2.0079
Error	23203.6614	109	212.8776	
Total	24487.1429	112		

Table VI

Pre-test and Post-test Means of Achievement Test
Scores Obtained by Groups A+E, B, C, and D

	<u>n</u>	<u>Pre-Test Mean</u>	<u>Post-Test Mean</u>	<u>Post-Test Mean (Adjusted)</u>
A+E	45	80.5333	114.5556	115.9308
B	23	81.6522	122.2609	121.9308
C	23	80.6522	122.3043	122.9554
D	23	83.1739	123.2174	121.3942

Table VII

Analysis of Covariance of Winter Quarter Examination
Points Obtained by Groups A-E, B, C, and D

Pre-Test = Covariate
Final Points = Criterion

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Treatments	592.1010	3	197.3670	1.5757
Error	13653.3071	109	125.2597	
Total	14245.4081	112		

Table VIII

Means for the Pre-Test and Winter Quarter Examination
Points for Groups A-E, B, C, and D

	<u>n</u>	<u>Pre-Test Mean</u>	<u>Final Point MeanQ</u>	<u>Final Point Mean (Adjusted)</u>
A-E	45	80.5333	162.6667	162.9400
B	23	81.6522	168.5217	168.4042
C	23	80.6522	167.1739	167.4056
D	23	83.1739	167.1739	166.5251

Table IX

Analysis of Covariance of Achievement Test Scores
Obtained by Groups A+E, and B+C+D

Pre-Test = Covariate
Post-Test (same instrument) = Criterion

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Treatments	1246.2943	1	1246.2943	5.9524*
Error	23240.8486	111	209.3770	
Total	24487.1429	112		

*.01 < p < .05

Table X

Pre-Test and Post-Test Means of Achievement Test Scores
Obtained by Groups A+E, and B+C+D

	<u>n</u>	<u>Pre-Test</u> <u>Mean</u>	<u>Post-Test</u> <u>Mean</u>	<u>Post-Test</u> <u>Mean (Adjusted)</u>
A-E	45	80.5333	114.5556	115.3206
B-C-D	69	81.8261	122.5942	122.0953

Table XI

Analysis of Covariance of Winter Quarter Examination
Points Obtained by Groups A+E, and B+C+D

Pre-Test = Covariate
Final Points = Criterion

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Treatments	551.7558	1	551.7558	4.4725*
Error	13693.6523	111	123.3662	
Total	14245.4081	112		

*.01 < p < .05

Table XII

Means for the Pre-Test and Winter Quarter Examination
Points for Groups A+E, and B+C+D

	<u>n</u>	<u>Pre-Test</u> <u>Mean</u>	<u>Final Point</u> <u>Mean</u>	<u>Final Point</u> <u>Mean (Adjusted)</u>
A-E	45	80.5333	162.6667	162.9383
B-C-D	69	81.8261	167.6232	167.4461

Table XIII

Use of programed text and workbook

When studying for the course, Psychology for Teachers,

I used the study aid --

	<u>A (Holland-Skinner)</u>		<u>C (Teevan-Jandron)</u>	
	no.	%	no.	%
seldom	15	68		
occasionally	4	18	3	13
about half the time	2	9	5	22
a good deal of the time			1	4
most of the time	1	5	14	61

APPENDIX I

To: Members of Groups B and D, Psychology for Teachers

SUBJECT: AUTOMATED INSTRUCTION LABORATORY

This year we are investigating the effectiveness of certain teaching aids, used in connection with the course Psychology for Teachers, A12-1,2. You have been selected to participate in that phase of the study which has to do with teaching machines. During the fall and winter quarters we should like you to schedule periodic visits to the Automated Instruction Laboratory. Here you will have an opportunity to study subject matter which has been programmed and will be presented to you on a special machine.

As a student and prospective teacher, you will find your work with programmed instruction stimulating and personally rewarding. Students at other universities have found difficult concepts in psychology easier to understand when presented in programmed form. Furthermore, the introduction of teaching machines represents part of a technological revolution in education with which you should be familiar.

Because it takes eight to ten hours to complete an entire program, you should spend at least eight hours in the Automated Instruction Laboratory during the fall and winter quarters. However, you are welcome to work at your own speed and to repeat portions of the program. Feel free to spend any amount of time in excess of the required eight hours.

Important. At some time during the next two weeks plan to make your first visit to the laboratory. Because preliminary directions and other arrangements take some time, 1½ hour periods have been scheduled. Indicate in the schedule folder the period you will be present.

To: Members of Groups A and C, Psychology for Teachers

SUBJECT: Supplementary Learning Aids

During the fall and winter quarters we are investigating the relative effectiveness of certain learning aids, used in connection with the course Psychology for Teachers, A12-1,2. You should find the use of these aids a valuable means for learning subject matter of importance.

Group A. Holland and Skinner's The Analysis of Behavior is referred to as a "programed text." With this book you should be able to instruct yourself "in that substantial part of psychology which deals with the analysis of behavior -- in particular the explicit prediction and control of the behavior of people." Although the text is not directly correlated with the Hilgard text and related lectures, the principles of behavior considered by Holland and Skinner are relevant to many topics discussed in class.

Note that the text is divided into sixteen parts, each of which contains from two to six sets of items. Directions for use of the book are presented on pages vii-viii. Read these directions carefully. The following suggestions are particularly important: "Read each item, write your response on a separate sheet of paper, and then turn the page to see whether your answer is correct. If it is incorrect, mark an 'x' beside it. Then read and answer the next question, and turn the page again to check your answer. Writing out the answer is essential. It is also essential to write it before looking at the correct answer.

By the end of the winter quarter you should have completed the entire text. Try to work at least three sets of items each week. It is important to do each item in its proper turn and not to skip items. If you have difficulty with a set, repeat it before going on to the next.

Group C. Teevan and Jandron's Student Guide with Programed Units is directly correlated with your textbook, Hilgard's Introduction to Psychology, and related lectures. "The first section of each chapter in the Guide makes use of a new technique of learning called 'programed instruction,' a method of self-instruction...The programed units are intended as a preview, not a review of the text chapters. From each programed unit you will acquire a beginning acquaintance with some of the key terms and concepts presented in the text; as a result, you should be able to read the text chapter with increased understanding." (Of course, you have already completed studying Chapters 1-4. Go ahead, anyway, and do the programed units for these chapters as a review for the first examination.)

Other important directions are presented on pp. xi-xiii. Read these directions carefully. The authors suggest that you make responses in the book, either by filling in responses or circling choices.

Use the Student Guide throughout the entire course. We believe that the careful study of programed units will materially increase the benefits you derive from your study of the text.